NASA STTR 2005 Phase I Solicitation

T6.02 Batteryless, Wireless Remote Sensors

Lead Center: KSC

Recently, an innovative communication scheme was demonstrated that increases the attractiveness of using Surface Acoustic Wave (SAW) sensors as the basis for wireless, passive, sensor networks. It now appears feasible that a moderate number of sensors could be distributed throughout a volume of space and interrogated remotely and individually. Such a capability is of interest to the space program in that it may provide a lightweight (no wires and small sensors), low maintenance (no batteries), sensing network that can be used in harsh environments (predicted temperature ranges are from cryogenic through 900° C). NASA is currently funding work on a distributed temperature-sensing network but seeks other advances in this area.

At the recent 2004 IEEE International Ultrasonics, Ferroelectrics, and Frequency Control 50th Anniversary Joint Conference, two papers on Orthogonal Frequency Coding for SAW Sensors were presented. This new communication scheme for SAW devices and sensors appears to offer the capability to develop sensing networks where individual sensors can be interrogated from among a distributed array of devices. It also appears to provide scaling of the system in both number and range while suffering minimal degradation in the time resolution of the echoed signals. Consequently, NASA has recently decided to fund the development of a demonstration system using this concept and using a selected sensor (most likely temperature).

But, further advances are sought in this area, particularly, but not limited to, the area of novel sensors. Both the Space Shuttle as well as future vehicles could benefit from distributed strain sensors allowing high resolution monitoring of airframe stress. Embedded sensors within high pressure dewars might indicate fracturing before destructive failure occurs. Sensors that can operate within a cryogenic environment without the heat loss associated with wires could offer level, pressure, or temperature monitoring capabilities that are difficult or impossible to achieve with current technology. Embedded corrosion sensors or other process monitors could provide useful data. For example, it might be advantageous to locate moisture sensors under the Shuttle's thermal protection system materials. Also, there is interest in distributed leak detection systems, where, for example, hydrogen could be detected before it accumulates to the 4% explosive level in air. In addition to sensor development, improvements to the overall system are sought. For example, improvements are desirable in antenna design or system architecture that increase range or sensitivity.

The goal is to provide new sensors and capabilities that are compatible with the Orthogonal Frequency Coding scheme recently demonstrated under NASA funding in order to increase the range of applicability of this concept.